What is the Indian Ocean Observing System?

The mission of the IndOOS is to provide sustained, high-quality oceanographic and marine meteorological measurements that support knowledge-based decision-making through improved scientific understanding, and ultimately, through improved weather, ocean, and climate forecasts.

Juliet Hermes, Roxy Koll and Lisa Beal, IORP members and IndOOS review authors
Why a review of IndOOS and roadmap to IndOOS-2?

- IndOOS design was established on the basis of an Implementation Plan drafted by the CLIVAR IORP in 2006.
- Since then, societal and scientific priorities and measurement technologies have evolved, many practicalities of implementation have been learned, and the pace of climatic and oceanic change has accelerated.
- The review findings provide a roadmap to address the clear and urgent need for expansion of the Indian Ocean observing system, designed to meet the requirements of a broad suite of users, as recognised in the GOOS 2030 Strategy.
Numbers of IndOOS-2

2000 + EMAILS
60 AUTHORS
35 MONTHS
25 CHAPTERS
6 REVIEWERS
3 EDITORS
3 WORKSHOPS

= 136 ACTIONABLE RECOMMENDATIONS
Review: Achievements of the IndOOS

IndOOS has provided unprecedented knowledge of weather, ocean, and climate phenomena, among them:

- Observations and forecasts of tropical cyclones and marine heatwaves
- Improved understanding of coupled convective modes (MJO and MISO) and their influence on global hydro-climate
- Mapping of the equatorial and monsoon circulations and variability of the Indonesian Throughflow
- Elucidated year-to-year climate variations in the tropical Indian Ocean (IOD) and their relationship to tropical Pacific climate variations (ENSO)
Review: Remaining gaps

- Low prediction skill of sub-seasonal to seasonal forecasts
- Large discrepancies in climatologies of heat exchange at the air-sea interface
- Lack of observations in western equatorial Indian Ocean (piracy and vandalism) and of boundary currents
- No sustained ecosystem measures
Roadmap for IndOOS-2: Core Findings

- Coverage of the western equatorial Indian Ocean needs to be completed.
- Biogeochemical measurements must be collected alongside physical parameters, initially targeted to regions of high variability and change, such as the OMZs and upwelling systems.
- Enhanced vertical and temporal resolution of upper-ocean measurements are needed in tropical regions strongly coupled to MJO and MISO development.
Roadmap for IndOOS-2: Core Findings

- **Boundary flux arrays** in the Agulhas and Leeuwin Currents are needed alongside an enhancement of Indonesian Throughflow monitoring.

- More **observations of the deep ocean below 2000 m** are needed to capture circulation, heat content, and sea level change. Initially targeted to subtropics.

- More land motion sites are needed alongside tide gauges, as well as additional island sites.
Sustained observations in the Indian Ocean

IndOOS-2: 2020-2030

Beal et al. BAMS 2020; Hermes et al. Frontiers in Marine Science
IndOOS Resource Forum, for implementing IndOOS-2

IndOOS Resource Forum (IRF) and IIOE2 can facilitate the implementation of IndOOS-2 recommendations, and maximize the use of the existing resources.

Coordination across platforms and regional basin scale programs has remained a priority of IORP and IndOOS and the IRF has helped achieve this, we continue to ensure that IORP has active regional scientist membership.
Core Findings: Beyond *in situ* Observations

- Continuous, overlapping *satellite measurements* are central to the IndOOS.

- There is urgent need for advancements in data assemblage and coupled data assimilation techniques.

- There is a need for increased investment and *stronger partnerships* with Indian Ocean rim countries and end-users, along with improved data sharing and commitments to best practices.
Why do we monitor and forecast these changes?

What counts in life is not the mere fact that we have lived. It is what difference we have made to the lives of others that will determine the significance of the life we lead, Mandela

Beal et al. BAMS 2020; Hermes et al. Frontiers in Marine Science 2019
Dissemination of the Impacts through Media

THE HINDU
TUESDAY, FEBRUARY 8, 2022

Marine heatwaves on the land are well known. But marine heatwaves—or the ones that form on oceans—have been on the rise in the waters around India, says a study.

Marine heatwaves are periods of extremely high temperatures in the ocean. These events are linked to coral bleaching, seagrass destruction, and loss of kelp forests, as well as sectors, such as tourism.

Hot topic: 85% of the corals in the Gulf of Mannar near the Tamil Nadu coast get bleached after the marine heatwave in May 2020. A rule of 0.5 events per decade and a rate of 0.5 events per decade bleached 94 events.

88% of the corals in the Gulf of Mannar near the Tamil Nadu coast get bleached after the marine heatwave in May 2020. Emerging studies have linked their occurrence and impacts in the global ocean, but are little understood in the tropical Indian Ocean. The study appears in the journal JGR Oceans.

The Western Indian Ocean region experienced the largest increase in marine heatwaving in the Indian Ocean and the Bay of Bengal over recent drying conditions over the central Indian subcontinent. Correspondingly, there is a significant increase in rainfall over south peninsular India in response to the heatwaves in the north Bay of Bengal.

"This is the first time that a study has demonstrated a close link between marine heatwaves and atmospheric circulation and rainfall," the authors note. "Climate model projections suggest further warming of the Indian Ocean in the future, which will very likely intensify marine heatwaves and their impact on the monsoon rainfall," Rony Mathew Roll, among the authors of the study and a scientist at the Indian Institute of Tropical Meteorology, Pune, said in a statement.

The study was conducted in collaboration with Sarenya J.S., Srilanka Agriculture University, Pauline Duquette (NIMD), and Ajay Anand (Cochin University of Science and Technology).

Heatwaves in IOR may be affecting monsoon: Study

Valmik Chandrasekhar

Mumbai: Marine heatwaves in the Indian Ocean have risen in frequency and size since the 1980s, with the largest increases seen in the western Indian Ocean and the Bay of Bengal, according to a new study. The trend has implications not only for the region’s weather but also potentially, the monsoon.

The study found marine heatwaves induced rainfall over central India and increased rainfall over the southern peninsula. The rise is due to rising ocean temperatures and El Niño events, as well as local factors, the study said, and is in line with global trends.

The western Indian Ocean saw a four-fold increase in heatwaves between 1985 and 2018 for a total of 66 events, the study found.

Indian Institute of Tropical Meteorology’s study found that marine heatwaves caused less rain in central India and more in the south. Both regions cooled, with the least undisturbed despite the ocean being among the fastest warming in the world, says Rony Mathew Roll of the Indian Institute of Tropical Meteorology in Pune, who led the study. Surface temperature in these waters rose by 7°C on average from 1950-2015, compared to the global average of 0.7°C.

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World Climate Research Programme

Climate change is a major global challenge affecting all countries and all sectors. It poses a threat to the well-being and the future of society and our planet. Understanding and addressing climate change requires a comprehensive approach that involves scientific research, policy development, and public engagement.

The Indian Ocean is one of the most rapidly warming regions in the world, with the potential to intensify extreme weather events and alter the monsoon, a critical source of rainfall for much of the region. These changes can have significant impacts on agriculture, water resources, and ecosystems.

The study highlights the need for continued research to better understand the complex dynamics of marine heatwaves and their impacts on the marine environment and human societies.

The findings also underscore the importance of multilateral collaboration and knowledge exchange to address climate change and promote sustainable development in the Indian Ocean region.
Growing the network and the impact

Co-design - To change the concept of making decisions for people with lived experience to making decisions with people with lived experience; seeing marginalised people as a burden to seeing marginalised people as resilient, creative and capable.
Individually we are a drop, together we are a fit-for-purpose ocean observing system.